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Students and Teachers as Developers of Visual Learning Designs With Augmented Reality for Visual Arts Education

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Abstract: This paper reports on a project in which communication and digital media students collaborated with visual arts teacher students and their teacher trainer to develop visual digital designs for learning that involved Augmented Reality (AR) technology. The project exemplified a design-based research (DBR) practice for visual learning design that utilised the competencies of diverse stakeholders throughout the design process. The project's pedagogical rationale for integrating digital technologies in the arts was that the visual digital designs should elicit different new art forms drawing on interactivity and social practices rather than replicate former art forms. Thus, the project participants explored the possibilities for developing a visual learning design based on digital communication technology and contemporary visual arts pedagogy. Furthermore, the project provided an exemplifying basis upon which to discuss the potential for reengineering the traditional role of the teacher/learning designer as the only supplier and the students as the receivers of digital learning designs in higher education. The discussion applies the actor-network theory and socio-material perspectives on education in order to enhance the meta-perspective of traditional teacher and student roles.

Keywords: visual learning design, augmented reality, teacher and student roles, actor-network theory

1. Introduction

How can we develop learning resources that meet the formal requirements for specific subject matter in higher education, support formal learning objectives for technology-enhanced learning and represent a novel approach that inspires students to go beyond traditional thinking? These questions may be resolved using a wide range of relevant and qualified solutions from a technological point of view, a learning theoretical view or a combination of both, thus suggesting the use of various combinations of learning designer competences. However, this paper addresses shifting the focus from the learning designer as developer to the main stakeholders of learning designs: namely the learners. The paper takes its point of departure in a case study, where bachelor level students were the principal developers of a learning resource for their academic peers with the same educational level but in a subject area that is different from their own. Thus, this paper will report on a project in which students became the learning designers for other students. Instead of involving students from similar domains, students from different domains with different competences participated in the project. The two lecturers that were involved in the project also played different roles as a facilitator and a stakeholder, respectively.

In the fall of 2016, a group of 15 bachelor level students in the Communication and Digital Media Department at Aalborg University participated in a project where they developed a digital visual learning design for and in collaboration with teacher students in visual arts education and their lecturer at University College Capitol. This paper reports on the project, in which mobile technology and Augmented Reality (AR) were utilised in the visual learning design. The project exemplified a design strategy that employed the competences of diverse stakeholders throughout the design process. This case was motivated by the evolution currently underway within visual arts education in a Danish context as well as the aspiration to create a resource based on state of the art knowledge of art pedagogy from the field by involving practitioners.

Since 1984, information technology (IT) has been a mandatory component in line with two- and three-dimensional art forms in elementary school as well as in art teacher education. However, many digital resources, such as Photoshop and Paint, offer the ability to remediate more traditional means of pictorial production rather than to facilitate the development of new art forms. Simulating a material process, but lacking the tactility experienced from real paint and canvas, makes one question the purpose of using digital technology for image production; thus, the material experience is lost if no new techniques are developed. Still, art production is occupied with pursuing still new modes of expression and ways to interpret the world. Even though schools do not produce artists, according to the German sociologist, Niklas Luhmann (1995), art communication is driven by the interest in challenging its own conditions for being art along with the desire to articulate still more refined ways of expression. This statement may sound too exclusive for an elementary or teacher training educational situation. However, art teacher students are in a training situation in which they are expected to develop

expressive and reflexive skills that are not purely instrumental but are part of their formation as individuals and professionals. In other words, working with digital visual production should provide teachers in training with a visual language that is adequate for acquiring the competences they need to understand and teach digital visual art. Thus, the project participants explored the possibilities for developing a visual learning design based on digital communication technology and contemporary visual arts pedagogy.

2. Students designing for learning in a complex educational situation

Theoretical discussions about learning design are approached from many perspectives, and the emergence of digital technologies has added new dimensions to the themes being discussed (Beetham and Sharpe, 2013; Mor et al., 2015). However, most discussions differentiate between the instructional position of the teacher or designer and the learning position of the student. The relationships between these roles are further framed by the content in a particular knowledge domain, and by the learning environment. Several pedagogical models exist for understanding designing activities, including those proposed by Jank and Meyer (1991), Hiim and Hippe (1997) and Beetham (2013), and these models are well known in a Danish educational context. All the models connect instruction and planning activities to the teacher's role either explicitly, as a part of a learning design model, or, as in Beetham's (2013) model for a learning activity, implicitly as part of the practice that is not present as a visible actor within the model.

These three pedagogical models address how we can think about organising learning for other people. Digital technologies add a dimension to the theoretical level of learning design, indicating that the relationships between the aspects of designing for learning activities might have to be approached in a specific way, where a student's role in the designing can be different from the traditional role as a receiver of instruction by a teacher or a computer programme.

The so-called reengineering of the relationship between learning design and learning may provide a step towards a more networked teaching-learning community where student competences, digital technologies and design principles produce the actual learning designs, thereby creating new ways to meet the students' learning goals in compliance with institutional educational documents as well as creating new roles for the teacher. The approach of attributing agency to both humans and non-humans is rooted in the actor-network theory (ANT) developed in the 1980s and further delineated by Latour (2005). Fenwick and Edwards (2010) and Fenwick et al. (2011) applied ANT to educational research. Bayne (2015) argued that an educational situation is both social and material, and it is much more complex than just adding a technological device. Bayne (2015) claimed that education is more complex than merely seeking to facilitate an individual's cognitive growth and more substantial than translating education to a matter of learning. Thus, Bayne (2015) argued against simplification and instrumentalisation of the relationships between digital technology and teaching and learning; she also noted the need to reframe the discussion using social material and ANT approaches. When discussing learning design, drawing on inspirations from ANT approaches provides a critical perspective on how the implementation of digital devices in the designing process of learning affects the main purpose of the learning situation.

Nespor (2012) argued that digital devices are the key to improvisation because they either slow things up/or down or cause organisational changes based on his analysis of the implications of implementing digital technology in educational institutions in the 1980s. Perhaps, giving students the task of designing for learning and asking them to integrate digital technology will result in increased improvisation? If the integration of digital devices promotes technological incidents that change education, does this also result in the potential to develop visual arts pedagogy? Winn and Lockwood (2013) reported on projects in which students in a higher education setting were designers for learning in a digital environment and were engaged in the production of their own learning content. Winn and Lockwood (2013) noted that one of the benefits of this approach to teaching, learning and curriculum development is that it requires a collaborate effort, which can pave the way for an open, peer-to-peer culture.

The project presented in this paper sought to explore the extent to which the processes of learning can take new forms when students serve as learning designers—not for themselves, but for students within another domain. This project was motivated by the desire to re-think learning designs and learning processes as a complex educational situation that emerge from ideas of visual pedagogy, but where the so-called reengineered teacher and student roles were as important as the incidents emerging from the improvisational potential of the digital devices.

2.1 Digital technologies in teacher training for visual arts education

Digital technologies are an integrated part of the learning objectives in Danish teacher training in visual arts education. From the 1990s, students were introduced to digital applications, such as Paint, Photoshop or Paint Shop Pro, which served the double educational purpose of being tools that they could use to explore their own artistic expression and to prepare themselves for their future teaching profession as designers of digital visual art activities in elementary schools (Buhl, 2002). The domain-specific content and methods of visual arts education had to be reconsidered in light of new ways of thinking connected to digital media rather than assimilating technologies to existing theoretical and practical frameworks (Buhl, 2002). In addition to the implementation of digital media in the Danish curriculum for teacher students, the Danish Ministry of Education's elementary school curriculum also embraced new tools for visual production. Rasmussen (2017) reported that the fear of not having the necessary IT skills needed to teach digital visual production is an issue among schoolteachers, even though IT has been part of the Danish school system's curriculum for many years. Rasmussen (2017) presented the results from a project involving fifth graders in which she collaborated with three schools to create an intervention with three different learning designs. Using digital technologies as an integral part of the learning objectives, she proposed a didactic model for facilitating visual learning with digital technologies (Rasmussen, 2017). Rasmussen (2017) demonstrated that students possessed digital skills that they gained outside of school, which is demonstrated in their mastery of iPads and the various applications involved, e.g. Stop Motion, iMovie, PhotoStory, etc. Visual aesthetic media resources derived from leisure were also examined in a 2004 project where ninth graders produced digital visual animations of a short story (Buhl, 2004). Although the process lacked digital arts didactics in the actual learning design, the students' visual production strategies demonstrated that they possessed skills from digital media, which they used as a strategy to subvert the formal agenda (Buhl, 2004).

Peppler (2010) reported on the absence of digital technology in visual arts education in a United States (US) context as the entrance to her social cultural field study of youths in a digital design studio. Her study showed that digital technology encouraged active learning, and she suggested that the enhanced use of digital media in visual arts education promoted democracy. In her study of teachers' classroom practices in a Swedish context, Björck (2014) emphasised the importance of drawing on the students' own resources to create a productive learning situation. She suggested that the teacher's role is transformed from being the one who has all the answers to being the one who guides students through knowledge situations. The teacher must know how to work with and evaluate aesthetic processes, and he/she must understand technology. Björck (2014) suggested approaching the teaching-learning situation as a visual event in which the classroom becomes a digital arena.

While the research studies presented above offer different perspectives, they all indicate that the integration of digital technology into visual arts education raises issues of how to understand the very core of the domain and how to develop an appropriate teaching role to engage with it. Furthermore, the studies showed that visual art students—whether fifth graders or ninth graders—possess the skills, thought patterns and motivation that are useful for exploring the visual potentials of digital-mediated content, which may emerge in educational settings where the actors—technology and humans—take on new roles. This indicates the potential for including students' resources in the processes of designing for learning.

The next section of this paper will report on the collaborative project in which the participants, who were higher education students and teachers in two different institutions and within two different knowledge domains, developed visual learning designs defined by a case. The project investigated whether reengineering the teacher-student-content roles promotes further integration of digital technology into visual arts education, not from a technology deterministic point of view, but with the aim of creating a new arena for visual meaning-making.

3. Digital visual arts and meaning-making outside the classroom

The technology for the design's visual production was AR, and the actual artwork was a concept for fluid visual experiences activated by a smartphone interface and a tag in a physical environment.

Dunleavy and Dede (2013) reviewed US endeavours related to implementing AR in educational systems and in informal learning environments. They found that AR enhanced learning by making the invisible visible, which is motivating for knowledge generation. However, Dunleavy and Dede (2013) noted that AR may cause cognitive overload in the learner, especially within the location aware AR environment, because the expanded visual

information increases the complexity of the learning situation, which may overwhelm the learner. The warning of cognitive overload indicates an issue that prompts further discussion of the complexity of a learning situation. The cognitive overload issue that stems from employing AR technology in learning designs adds further dimensions to Bayne's (2015) argument about the complexity of higher education teaching and learning processes. In teaching and learning environments, digital technology interacts with other social and material actors (Bayne, 2015). Based on Bayne's (2015) point about the complexity of educational situations, our project focused on designing for learning practices, where communication and digital media students took on the role of designers of a visual learning design for art teacher students. We created a new setting for learning design, where the students could draw on and integrate the skills and resources they had from using digital technologies during their leisure time.

A similar but somewhat different model was used in another project conducted by Buhl and Ejlsing-Duun (2015). They reported on a project where master's degree students in Nordic Visual Studies and Art Education (NoVA) produced visual aesthetic experiences drawing on AR technology and local urban environments. They investigated the artistic exploration, design and testing of a visual design structured from a DBR approach, initiated by Amiel and Reeves (2008). The blended and distributed e-activities provided a new approach to visual arts education. Furthermore, the learning design for the students was based on a design principle for theory-generating practice (TGP). The key concept of TGP is that theoretical knowledge is derived from practical experience, which frames the students' learning processes in a way that supports their experiences through actual "doing" and "living through" a learning activity in a practical way in technology-supported environments (Buhl, 2016, p. 3). Buhl (2016) argued that these processes provide students with bodily knowledge that emerges from the actual performance of a learning activity, and this knowledge constitutes a TGP. Furthermore, Buhl (2016) argued that this approach to learning enhances the students' ability to identify and work with the challenges that emerge during the learning process in a way that elicits issues that can be reflected upon theoretically; this gives rise to the generation of new knowledge and further develops the existing theory.

However, in Buhl and Ejlsing-Duun's (2015) project the activities remained within the same domain, and the visual designers were master students who had visual production competences and knowledge about contemporary art. Furthermore, their target group was art tourists and not art teacher students. This implies that there was no formal learning agenda; instead, the agenda was about urban awareness.

3.1 Collaborative learning designs

The current project shared some similarities with Buhl and Ejlsing-Duun's (2015) NoVA project in terms of producing visual aesthetic experiences drawing on AR technology and local urban environments to explore, design and test a visual design structured by a DBR approach on the basis of TGP as a design principle. However, the current project differs from the NoVA project in that the designers (communication and digital media students) developed a resource for learning in another formal educational system, which was represented by visual art teacher students. Their starting point was communicative and digital media expertise, but they had no visual arts education expertise. Another difference between the current study and the NoVA study was that the visual arts education teacher training lecturer at the other institution took on the role of the customer who initiated the case, and to whom the students should deliver their solution. Thus, the teacher trainer and the art teacher students were stakeholders who collaborated with the communication and digital media students to contribute diverse competences to the process of developing the learning resources for visual arts education. The communication and digital media students' teacher was the designer of the overall framework for the project and collaborated with the teacher trainer to develop the case in order to set the scene for the communication and digital media students' work. During this process, the communication and digital media students attended relevant lectures and supervision at their home university together with other students who worked with the same structure, but with different cases.

3.2 Introducing the case and the process to the communication and digital media students

On the first course day at the university, the communication and digital media students were introduced to the case. The case description informed the students about the overall learning goal for the teacher students in visual arts education and the conditions for teaching the programme. The visual arts teacher student programme in Denmark is a part of the general teacher education programme, where students specialise in three subjects (visual arts is one of the options they can choose). During the programme, the students achieve competences in teaching visual arts from first through ninth grade in an elementary school. In order to achieve these teaching

competences, visual art teacher students are required to work with image production in various media, including digital media for expression. Furthermore, they are taught to transform art practice skills into didactic competence in order to prepare them to teach visual arts to schoolchildren. The case description further informed the communication and digital media students about the nature of the assignment, which consisted of a framework in which they were asked to create a learning design that included AR that supports teacher students designing visual experiences in an urban space, and which also facilitates the development and sharing of their personal expression. The case description stated that the goal was to facilitate a learning process where the participants comprehended the possibilities in visual art production, including digital technology, but under the condition of the specific knowledge domain of visual arts education. Furthermore, the design had to facilitate social and shareable image production. Smartphone technology and apps, such as i-nigma and Instagram, were suggested as tools to create an AR experience. The students were free to use other technical solutions, but the technological part should not be an obstacle impeding the visual learning design part. Finally, the students were introduced to DBR, which is a pragmatic research approach that combines an iterative development of a design with research and which aims to improve a design and to develop a theory with an emphasis on cooperation between the designer and the stakeholders. The students had six weeks to develop a proposal for a visual learning design based on collaboration and theory, test it, write a report that presented the theoretically reflected prototype, and discuss it in an oral exam.

3.3 Case results

Three groups consisting of five communication and digital media students developed three visual learning designs that showed opportunities for working with AR experiences in very different formats that were not traditional re-mediated applications. During the process, the students were challenged to integrate their theoretical and practical knowledge of the field of study, but the DBR approach provided a structure for them to collaborate with the stakeholders on the learning designs. They interviewed art teacher students and teacher trainers as part of their preparatory fieldwork, and tested and discussed the iterations of their mock-ups with them. As a result, three prototypes for visual learning designs showed opportunities to learn through AR experiences in very different formats beyond traditional re-mediating image programmes. The first example was the development of a design called *Share Your Art*, which aimed to provide a tool for common appreciation of urban art. In this app, the user takes a photo of an artwork that is placed in a physical location in the city; in addition to sharing the photo, the user also visually alters the photo to create a personal interpretation on his/her smartphone, which can be shared with fellow users of the app. This creates an AR experience, which can be activated by the next user who views the artwork at the same location. The second example was a design called *Picsapp*. The user chooses a location and a self-produced image stored in the smartphone, which is applied to the location, thereby providing an AR experience of creating a work of art for a specific place. The producer captures his/her new artwork and shares it with others. These two example low-fidelity prototypes for the development of a digital application that did not involve technology. The third example was a high-fidelity prototype based on a free AR-app, *Zappar*. This learning design made the user choose from among three approaches for a visual production in three steps: an instruction video, an assignment and an archive, where the result is uploaded for sharing. The assignment is based on the principle of producing both analogue and digital images in accordance with a chosen location; thus, it refers directly to a paragraph in the formal document for visual arts teacher education.

All three examples focused on the user as the producer of a visual experience based on the principles for art production in the Danish visual arts education curriculum. The communication and digital media students met the case requirements for designing in accordance with developments within digital media, visual culture and contemporary art, representing ideas of community, social interaction and participation. At the same time, the ideas of social learning and learning through art production were integrated, as were the students' technology-supported learning practices outside the classroom. From a visual arts education perspective, the visual learning design apps represent a transformation of former ideas of creating original, personal, technical skill-based manipulation of a medium, such as canvas, clay, paint, etc.

The visual learning design process showed that cooperation can promote new aspects of visual arts didactics, where visual art pedagogy gains new opportunities for development and practitioners can integrate digital technology into school subjects. From the perspective of the communication and digital media students, the design case released them from the institutional frameworks of their own university and provided them with a problem that forced them to collaborate with stakeholders in another domain. The stakeholders were experts

on domain-specific issues, but they were novices in digital and communication design. After the project, two communication and digital media students emphasised that the possibility to speak with experts in the subject was very helpful, as was the opportunity to obtain an immediate response from their pitches and mock-ups. The teacher trainer emphasised that her students suddenly had to articulate their own teaching subject to outsiders, which forced them to reflect on the meaning of visual arts education.

4. The potential of students developing learning resources for student peers

This paper began by asking how we can develop learning resources that meet the formal requirements for specific subjects in higher education, support formal learning objectives for technology-enhanced learning and provide a novelty experience that inspires students to go beyond traditional thinking. The discussion focused on reengineering the traditional roles of teacher, learners and learning content. Supported by ideas from ANT, the teacher-student roles were changed in order to create another starting point for designing for learning. The students' learning designs had to integrate new trends emerging from the development of digital technology and from contemporary art and visual cultures. The results should be the development of adequate learning resources to bridge the generational gap between digital users and to obtain a broader understanding of the diverse actors involved in an educational situation. One might ask, can students learn in new ways by being each other's learning designers?

The extent to which the endeavour has succeeded cannot be answered unambiguously. For one thing, the process that was described could never occur without the university lecturer having an overall overview of the components of the process. This means that student designers of learning require a learning design from the university teacher, but on another level. Moreover, the duration of a six-week course is not long enough to show evidence of the outcome or be compared to the longitudinal description reported by Nespor (2012). However, studies have indicated that the complexity of educational situations cannot be addressed by methods that focus on simplification (e.g. Bayne, 2015). Furthermore, the research in visual arts education (e.g. Björck, 2014; Rasmussen, 2017) has shown that the implementation of digital technology into teaching practices requires a rethinking of pedagogy rather than adding on to former ideas about teaching.

Using students as designers of learning as the starting point creates new ways of thinking for university teaching and new ways of thinking about learners. In the project presented in this paper, the students were given responsibility not only for their own learning process, but for how their actions influence the learning processes of others. They experienced that they had to use their knowledge, search for and achieve new knowledge and collaborate with others in order to achieve their goal. Furthermore, they experienced that their work is applicable to real-life practice. Perhaps this reengineering of educational actors and the resulting new thought patterns will provide inspiration for other teaching domains as well.

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